Aquaponic Development

Mapping out the benefits of utilizing an aquaponic system on a large commercial scale with AquaEco Environmental Services, Inc.

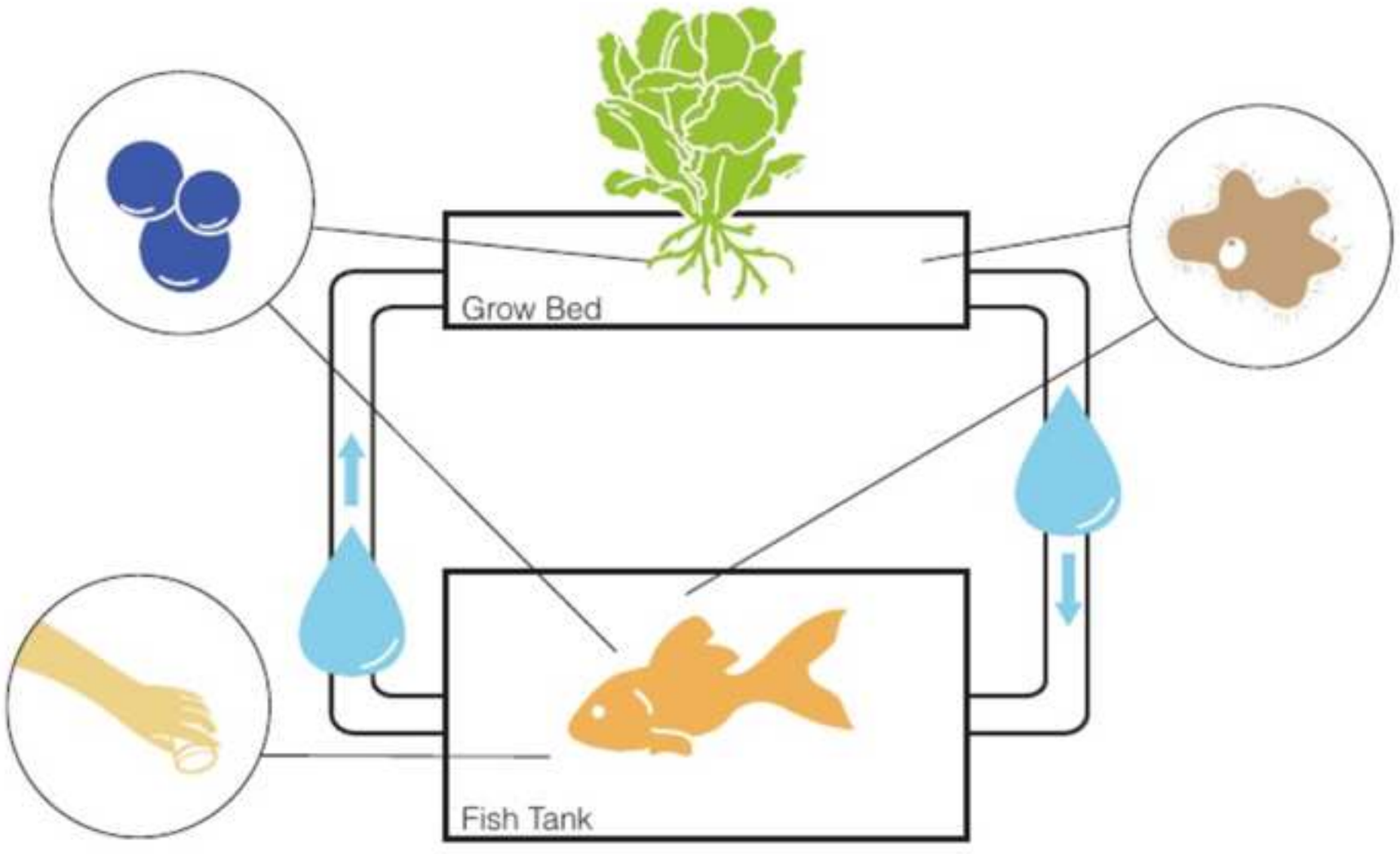
AquaEco
Environmental Services, Inc.

Defining an Aquaponic System

Aquaponics is the integration of:

- ***Aquaculture***- *is the farming of fish, crustaceans, mollusks, aquatic plants, algae, and other aquatic organisms.*
- ***Ponos or Ponics*** – The Greek word for Labor

How Aquaponics Works



Fish are fed food and produce Ammonia rich waste.

Bacteria breaks down the Ammonia into Nitrites and then Nitrates.

Plants take in the converted Nitrates as nutrients.

Water in the system is filtered by the plant roots and by the grow medium.

Oxygen enters the system through an air pump and during dry periods.

Why is Aquaponics considered sustainable?

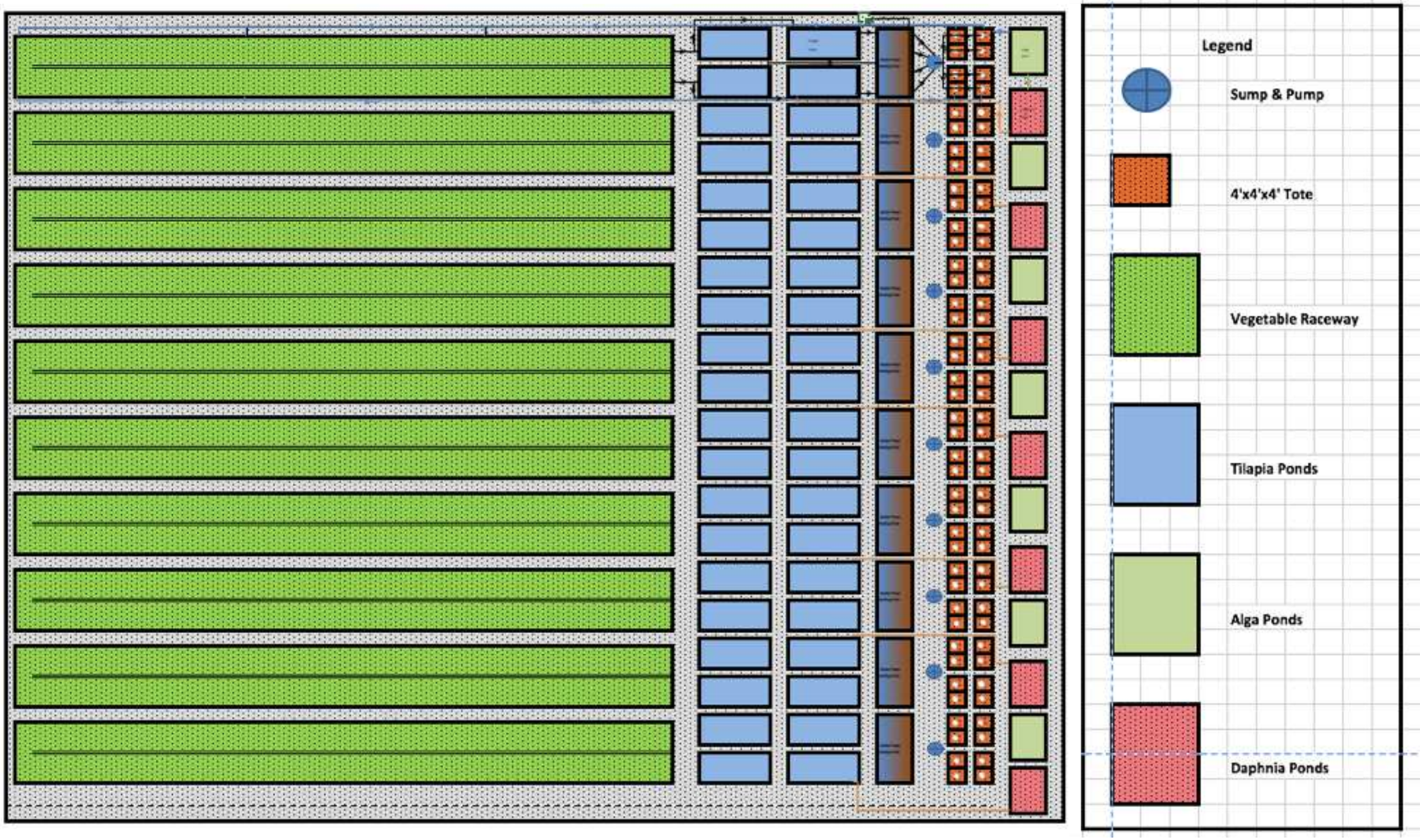
- Waste from fish is used to feed the plants
- Fish and plants create a polyculture producing two products
- Water is re-used in the re-circulating system
- Local food production, enhances the local economy and if located near population, reduces food transportation.
- Continuous organic fertilizer

Source: ATTRA – National Sustainable Agriculture Information Service

Why Aquaponics?

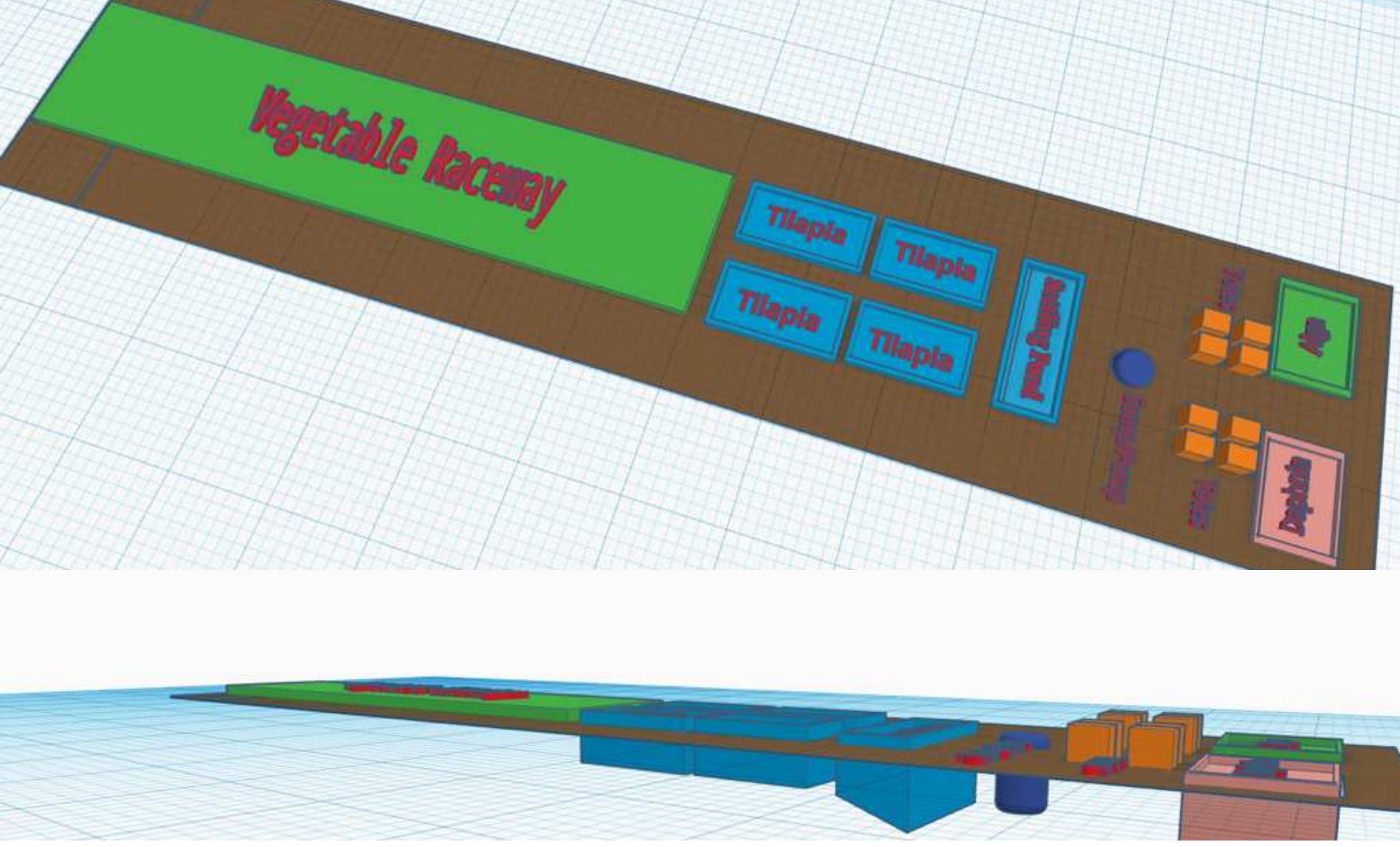
- Uses a fraction of the water, about 10% of soil growing
- No need to purchase, store and apply fertilizer
- No soil-borne diseases, no tilling, no weeds
- Grow two food products together, animal protein and vegetables
- High fish stocking density, high crop yield
- No waste – hydroponics waste solution, aquaculture waste fish solids – aquaponics all waste is used
- No pesticides or herbicides, only fish fertilizer
- Works in draught or places with poor soil quality
- Small Footprint with large yields

How does an **AquaEco** designed Aquaponic system look and work?



Custom Design/Build

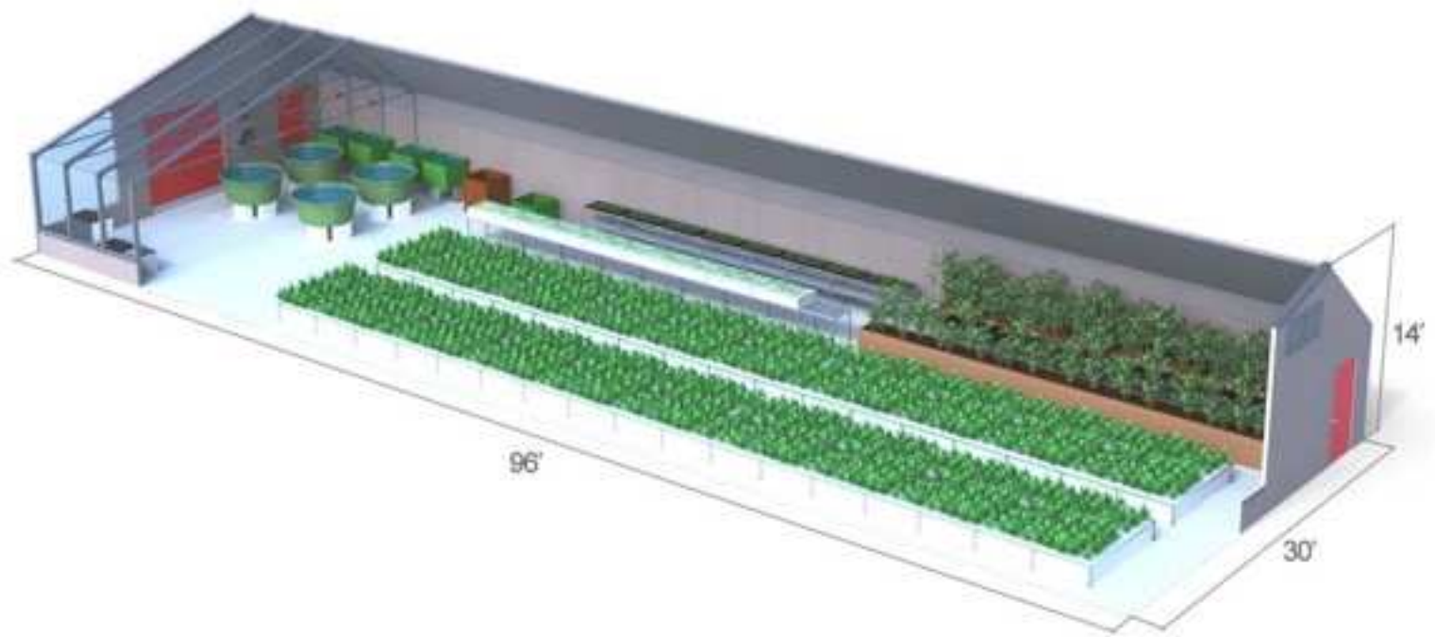
1 acre Aquaponic system
for Hyderabad, India



Example of a Single Node System

Raft Method Aquaponics

- Method researched and developed at University of Virgin Islands
- Perfected by Bob Warwick, our Head of Research and Development at *AquaEco Environmental Engineering*



Raft Method Aquaponics

Pros:

- Great for commercial setups
- Very high yield of both fish and plant crops
  - Full Acre System in India- 278,560 Fish in 1 year, 1,966,500 Plants in 1 year.
- Typically installed inside a greenhouse (although in tropical locations they are outside)

Raft Method Aquaponics

Cons:

- Requires more extensive filtration methods
- Usually grows a specific crop like lettuce or basil
    - This can be mitigated by having different nodes for larger systems
- A need of constant reliable electricity

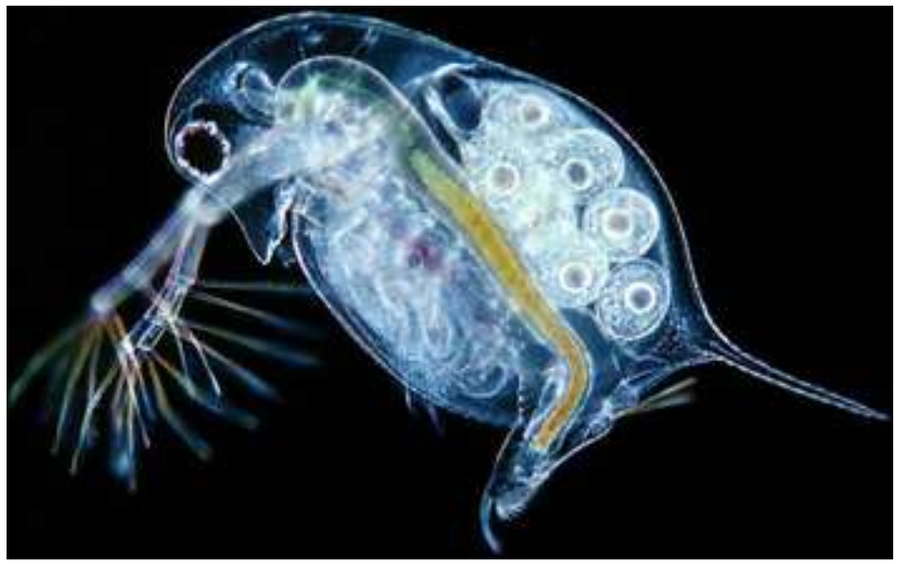
What Makes AquaEco's System Different?

- The Problem with Traditional Aquaponic Systems:
  - Fish food is expensive, unsustainable and increasing in demand due to rise of aquaculture
- How Our System Addresses This:
  - Relies primarily on natural sources for fish food by mimicking the food chain found in nature
  - Produces better-quality growth and health with lower mortality rates in fish

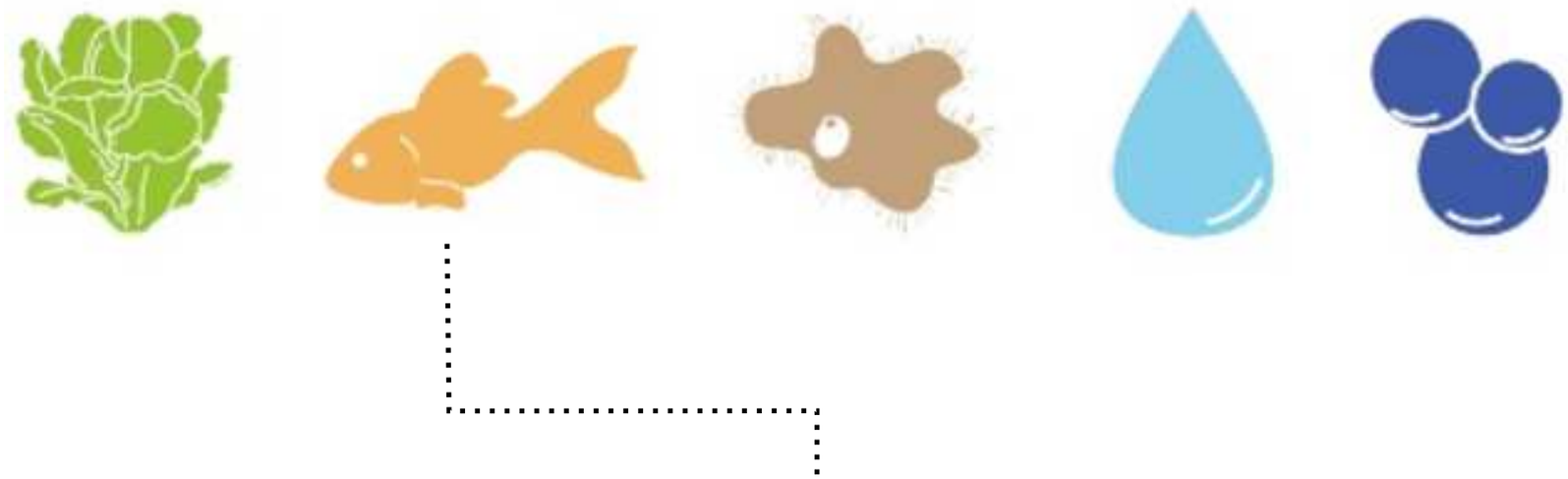
How Does This Work?

- We begin by growing algae that is high in quality vegetable protein and Omega 3’s
- Algae is fed to daphnia, small freshwater crustacean's
- Daphnia is fed to the tilapia, which is their source of food in the wild
- Only input needed is CO2 and nutrient filled water circulated from the fish
- **Need to purchase fish food is dramatically decreased**

Algae



Daphnia



Understanding Fish in an AquaEco Aquaponic System

Fish Inputs and Outputs

- Inputs: Feed, Oxygen, and Water
- Outputs: Urine (water), Ammonia, Carbon Dioxide, Feces, Uneaten Feed
- Water Recirculation Cycle
  - Fish tank >> Solids Removal >> Biofiltration >> Aeration/Oxygenation

Our Fish of Choice: Red Tilapia

- Commonly used in aquaponics
- Warm water fish (82-86*). Tropical Fish can not survive in temperate zones, making them environmentally friendly.
- Tolerates poor water conditions, better than other fish: pH shifts, temp changes, high ammonia, and low dissolved oxygen
- Omnivorous – pellet fish food, duckweed, veggies from the system
- Grows to plate size in about 6-9 months (ideal conditions). Faster than other fish.

Temperature and Growth Rate

CMAX= Max. feeding rate

SDA = Digestion (specific dynai action)

F = Feces, urine production (egestion)

U = Ammonia production (excretion)

ΔB = Change in fish weight

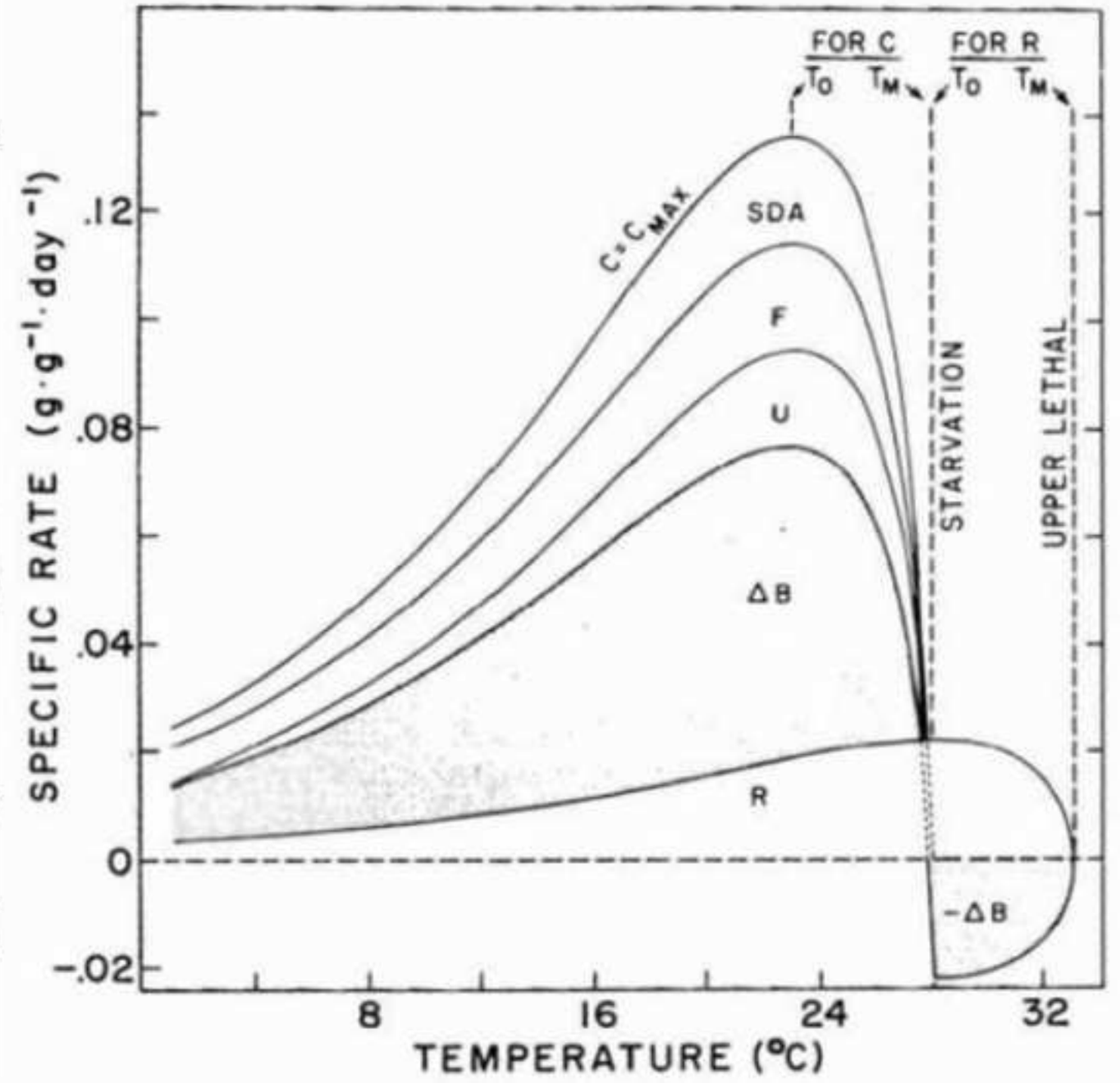
Opt. coolwater temp. = 23 C (

R = Respiration

Max. = 28 C (82 F; starvation)

Coldwater fishes = 14-16 C (57 F)

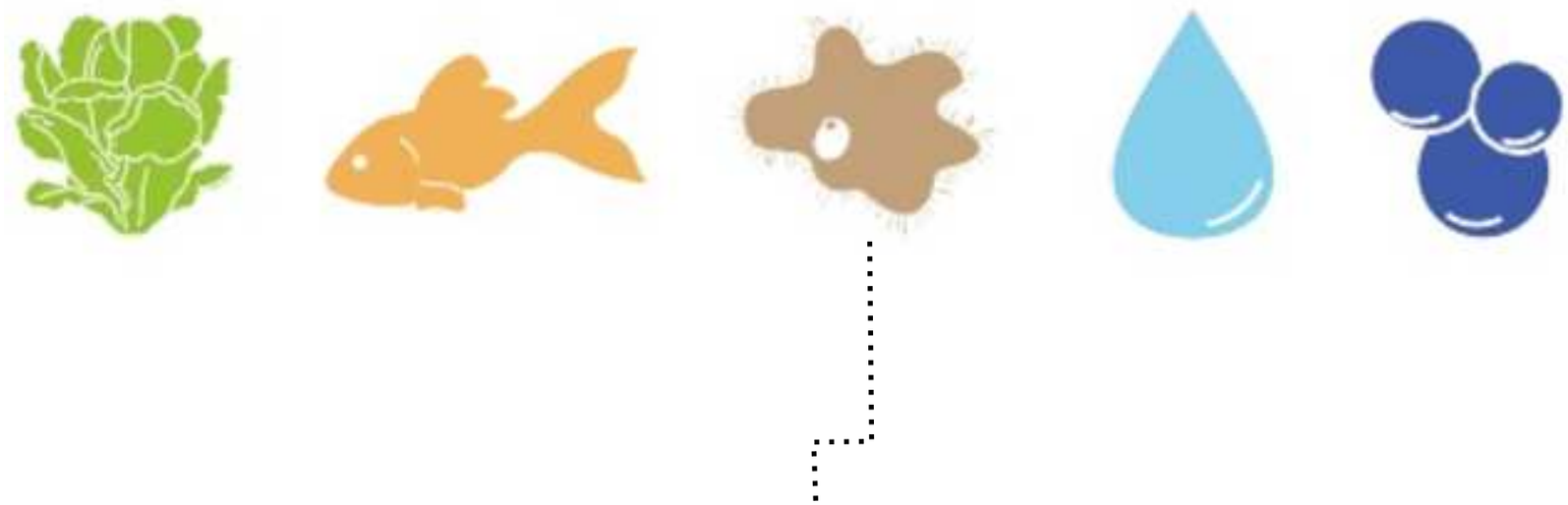
Warmwater fishes = 28-30 C (86 F)



Feed Conversion Ratio and Comparison

The Average Pounds of Feed to Produce 1lb of Product

- Fish – 1.7lbs
- Chicken – 2.4lbs
- Turkey – 5.2lbs
- Pork – 4.9lbs
- Lamb – 8.0lbs
- Beef – 9.0lbs



Understanding Bacteria in an AquaEco Aquaponic System

The Bacteria

- 50% of fish waste is in the form of ammonia released through urine, fecal matter and gills

- Bacteria consume fish waste, decaying plant matter and uneaten food

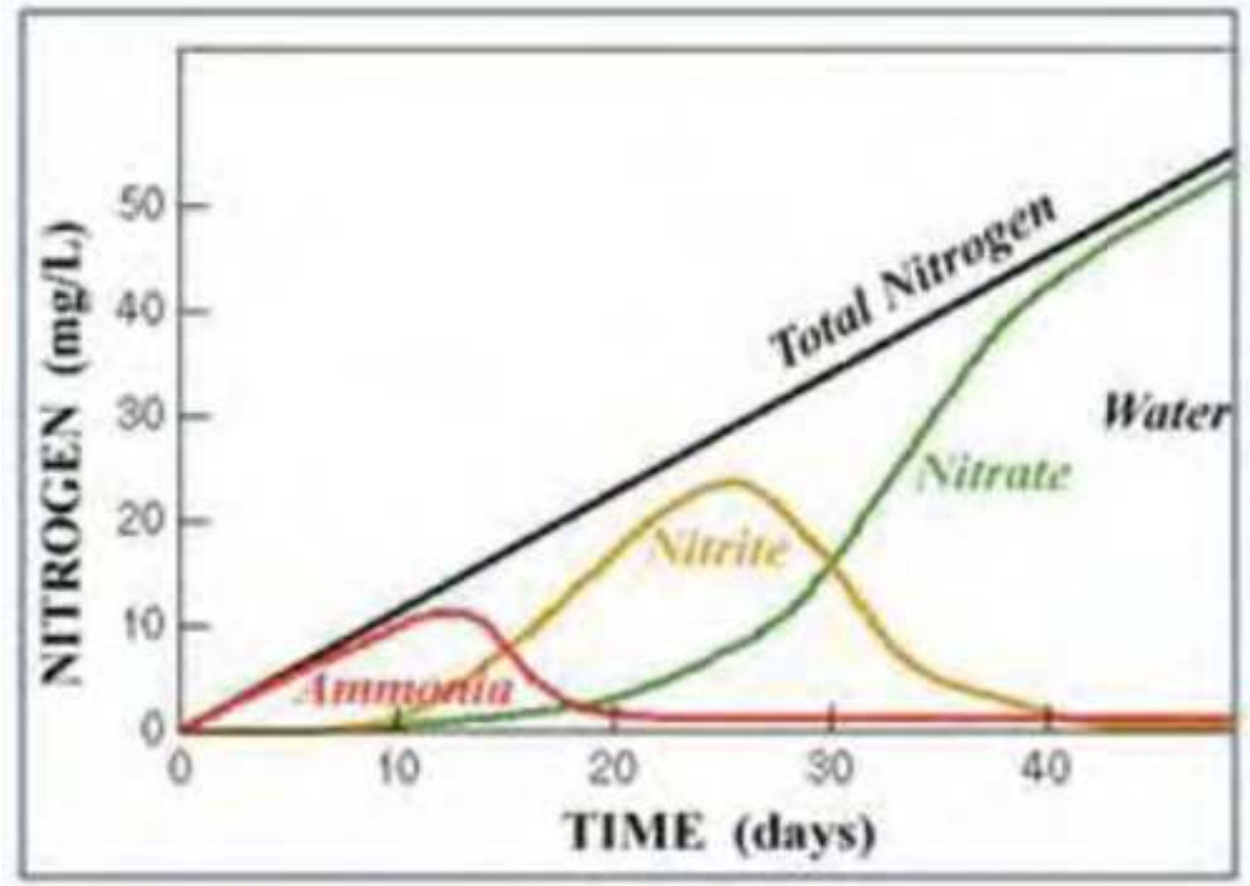
- Bacteria nitrosomonas converts Ammonia (NH3 or NH4+) to Nitrite (NO2-) – Nitrite is toxic to fish

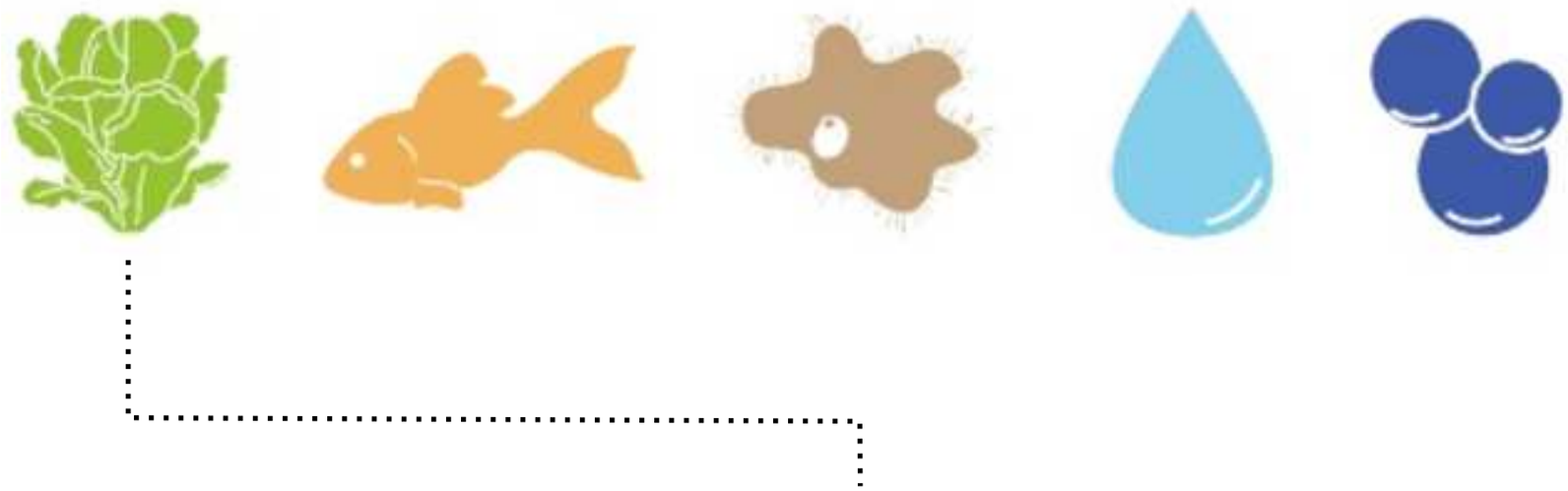
- Bacteria nitrobacter converts Nitrite (NO2-) to Nitrate (NO3-) Nitrate is primary source of plant nutrition

- Nitrogen is the good stuff – it is relatively safe for fish and great for growing plants

Bacteria (Nitrification) Cycle

- Rising Ammonia for 10 days
- Then Nitrite levels rise and Ammonia levels fall
- Another 10 days, Nitrate levels rise, Nitrite levels fall
- Total 20-30 days to stabilize





Understanding Plants in an AquaEco Aquaponic System

Plants to Grow

Vegetables:

- Lettuce
- Bush Beans
- Bush Squash
- Broccoli
- Cauliflower
- Peppers
- Peas
- Spinach
- Okra

Herbs:

- Basil
- Thyme
- Cilantro
- Sage
- Lemongrass
- Wheatgrass
- Oregano
- Parsley

Fruit:

- Strawberries
- Tomatoes

Flowers:

- Most Garden Varieties

Plus More

Why do Plants like Aquaponics?

- Nutrients constantly provided
- Warm water bathing the roots
- Plants do not have to search for water or food
- Less effort needed in putting out roots
- All the energy goes into growing UP not DOWN
- No weed competition

Vegetable Highlights: Lettuce

- Lots of different varieties
- Really easy to grow
- Ready to harvest in about 30 days
- Shallow root system
- Ideal Temp 60-80F*, can tolerate down to 45F
- As long as water temperature stays around 72F this will prevent bolting regardless of air temp.

Vegetable Highlights: Basil

- Most popular aquaponic herb
- Fast and easy to grow
- Good market price and high demand
- Likes good light, but shade mid-summer
- Lots of varieties
- Continuous harvest
- Ideal temps 68-75*
- Use fresh or dried Basil

System Maintenance

1. Feed the fish daily, monitor fish health

2. Test water quality (every other day for the first month, then about once a week, then as needed)

3. As needed clean out solid waste settling basin, bio-filter, etc.

4. Check plant health, trim back, harvest or take cuttings

5. Check plants for bugs or nutrient deficiencies

Now that you understand how an **AquaEco** Aquaponic System works. Why would you want to partner with us?

AquaEco Environmental Services

- Proprietary Technology Developed by Bob Warwick, Head of Research and Development

- Brian Foster, CEO, installed the largest aquaponics system in the world in partnership with Urban Organics/Pentair

- Years of experience in developing and building aquaponic systems across the US

- Team of biologists, engineering, and construction experts

- Ongoing support and training provided. Along with business and marketing team to assist in the sale of produce.

Get in Touch:

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AquaEco
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